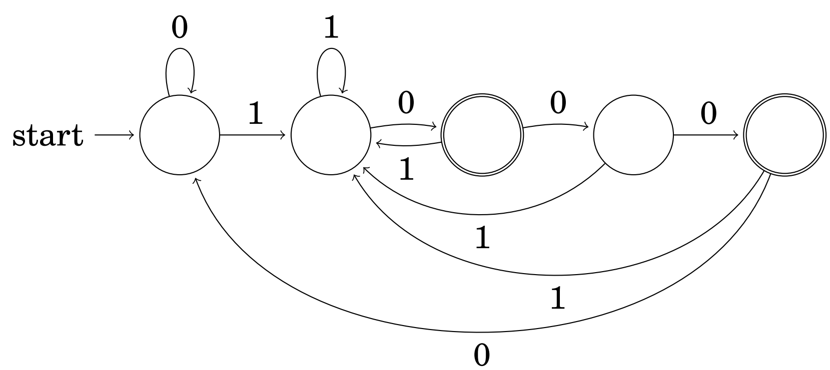
Problem 1

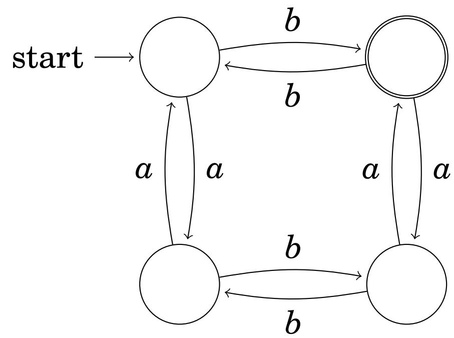
Construct a DFA that recognizes strings in $\{0, 1\}*$ with the following property. Each string, when interpreted as a binary number, is congruent to 3 modulo 5.

> If a number reduces $3 \pmod 5$, then it must reduce either $3 \pmod{10}$ or $8 \pmod{10}$. Therefore the binary digit representation must end in either a $3 \equiv (10)_2$ or $8 \equiv (1000)_2$. Therefore we make a machine that only accepts strings with either of those endings.
>
> 
>

Problem 2

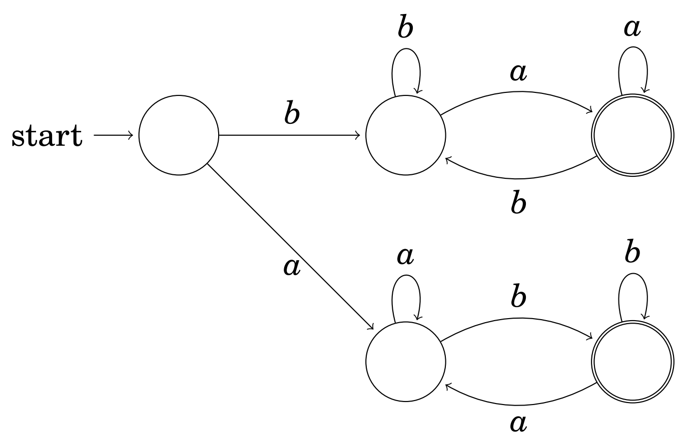
Design a DFA over the alphabet $\Sigma = \{a, b\}$ that accepts all strings with an even number of instances of the letter a and an odd number of instances of the letter b.

> We create a state for each possible pair of parities of a and b and appropriately transition between them.



Problem 3

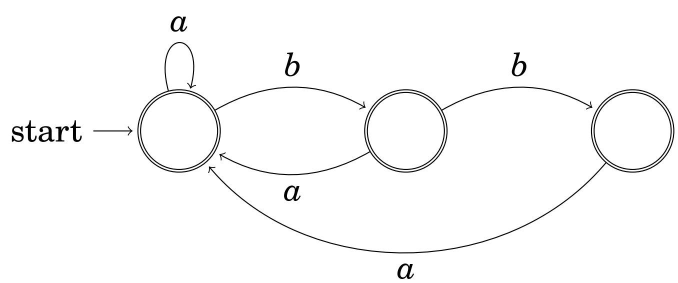
Give a simple English description of the language recognized by the following machine



> The machine recognizes strings whose starting and ending letters are different.

Problem 4

Give a simple English description of the language recognized by the following NFA



> The machine recognizes strings that dont contain a substring of b's more than 2 letters long.